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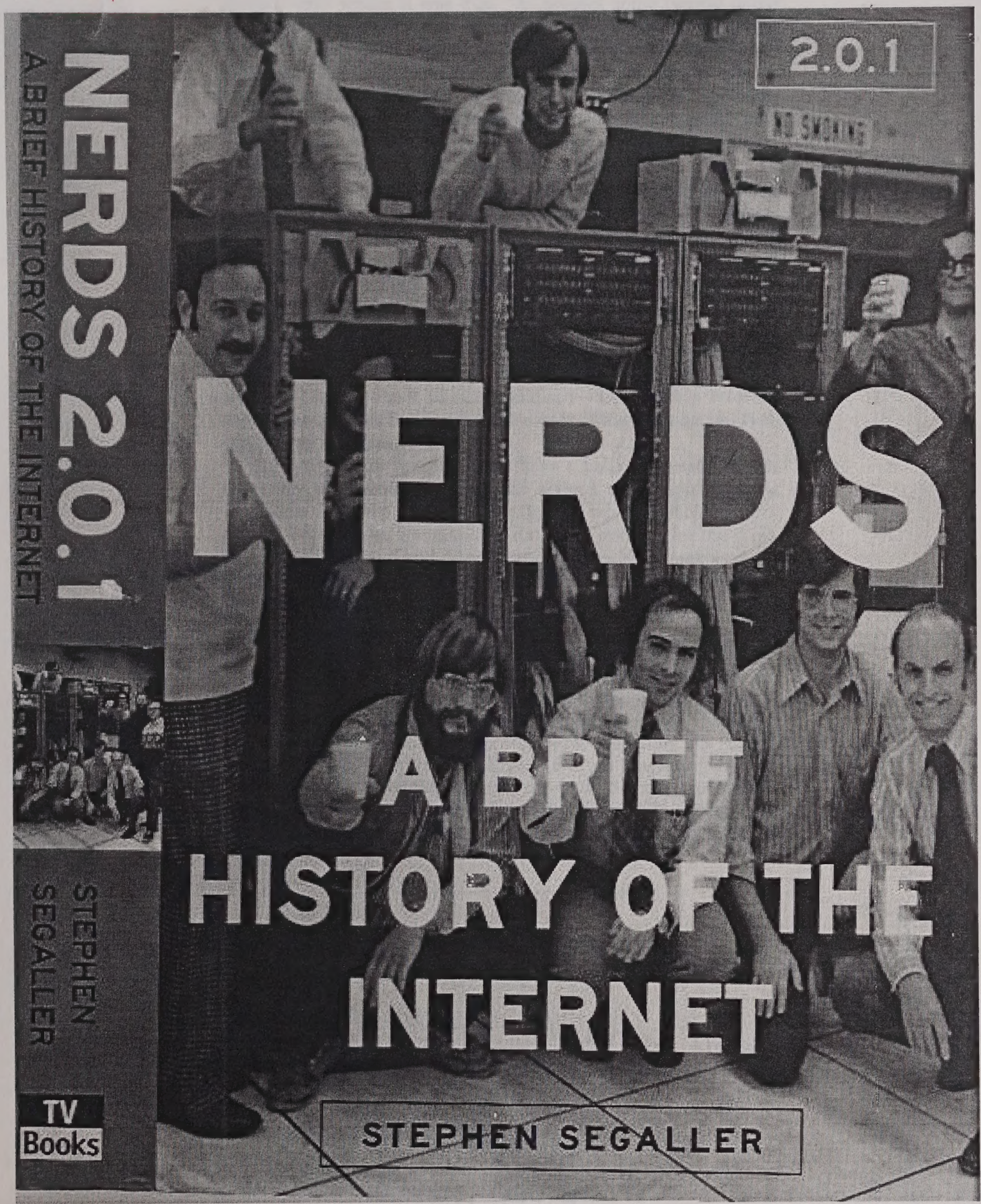

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Brand's article mainly focused on the growing campus passion for computer games. But it reported on the status of the ARPAnet, giving credit where it was due. "At present some twenty major computer centers are linked on the two-year-old ARPA Net. Traffic on the Net has been very slow, due to delays and difficulties of translation between different computers and divergent projects.... The trend owes its health to an odd array of influences: The youthful fervor and firm dis-Establishmentarianism of the freaks who design computer science; an astonishingly enlightened research program from the very top of the Defense Department..."

Seeing the Pentagon thus complimented in *Rolling Stone* must surely have been a unique occurrence. Brand did indeed foresee uses for networks that have barely been achieved today: "Since huge quantities of information can be computer-digitized and transmitted, music researchers could, for example, swap records over the Net with 'essentially perfect fidelity.' So much for record stores (in present form)."

He also reported on a classic political-action effort, Resource One. Led by Pam Hart, it was located in a five-story warehouse south of Market Street in San Francisco—the very hip location that in the nineties has become the center of the Website and Web publishing industries.

The activities of Resource One have a political period flavor: databases to coordinate "all of the actions on campus" during Cambodia invasion protests; investigative work on major corporations; research on foundations; statistical systems for the city's free clinics (for free) and other health centers (for a fee); and political analysis of assessor's tapes and census tapes, city records, and education records. This was the social movement devoted to "Computer Liberation."

Stewart Brand and others were applying the *Whole Earth* slogan "Access to Tools" to explore making computers what today we know they should be: user-friendly, timesaving devices to access information, provide cheap communication, and make information a less protected commodity. Somewhat inevitably, the base of operations was Sausalito, the hippest of hippy communities, in a variety of derelict—or charmingly renovated—tugboats and sloops.

Another of these liberators was Theodor "Ted" Nelson, another disappointed disciple of Engelbart: "The whole point of

Excerpts from:

Nerds 2.0.1 A Brief History of the Internet

by Stephen Segaller,

TV Books, 1998

computers was to enhance the work of the human mind. What Doug Engelbart calls the augmentation of human intellect. [He's a] wonderful, wonderful saint. The augmentation of human intellect [is] helping people think better and deeper thoughts and compare things more deeply. So I had expected a [rise] in the level of human discourse from all this."

The gospel according to Theodor found its expression in his remarkable, reversible book, published in 1974. One front cover was titled *Computer Lib*, and the other (the back) was *Dream Machines*. Nelson, a Harvard-educated fount of hacker energy and hyperactivity, invented a version of the World Wide Web about twenty-four years before it finally took shape. He named it "Xanadu," in romantic tribute to Coleridge's unfinished, drug-enhanced poetic vision. Nelson's Xanadu has failed to materialize as surely as the "person from Porlock" drove Coleridge's dream beyond recall.

Ted Nelson originally invented the word "hypertext" for "nonsequential writing." As a writing and editing device for moving between documents, or between storage locations, it has been at the heart of personal computing, and in its Web incarnation (http, or hypertext transfer protocol) is ubiquitous on the Net.

Reading between the lines of the seventies jargon of hip liberation, one sees that *Computer Lib* provides a startlingly simple, digestible account of what computers do, how they work, and why their mystique can (and should) be challenged. The book is printed in broadsheet, newsprint fashion. The first column begins thus:

Computer Lib
'You Can and Must Understand Computers Now'
© 1974 Theodor H. Nelson
Additional copies are $7 postpaid . . .

Any nitwit can understand computers, and many do. Unfortunately, due to ridiculous historical circumstances, computers have been made a mystery to most of the world. . . .

This book is a measure of desperation, so serious and abysmal is the public sense of confusion and ignorance . . .

This book is therefore devoted to the premise that EVERYBODY SHOULD UNDERSTAND COMPUTERS. It is intended to fill a crying need.

In the *Computer Lib* half of the book, Nelson lists his "author's credentials"—B.A. in Philosophy from Swarthmore, graduate study at the University of Chicago, M.A. in Sociology from Harvard, listed in the New York Times *Who's Who in Computers.* On the corresponding page of *Dream Machines*, one finds the "counter-culture credentials"—"Writer, showman, generalist. Gemini, moon in Libra, Gemini rising. Author of what may have been the world's first rock musical. . . . Photographer for a year at Dr. Lilly's dolphin lab, Miami. Attendee of the Great Woodstock Festival." This is a seventies polymath, whose range of interests and experience presaged the technological, social, and artistic integration of the nineties Internet world. This is indeed what Nelson had in mind when he wrote *Computer Lib*:

> I have an axe to grind: I want to see computers useful to individuals, and the sooner the better, without necessary complication or human servility being required. Anyone who agrees with these principles is on my side, and anyone who does not, is not. THIS BOOK IS FOR PERSONAL FREEDOM, AND AGAINST RESTRICTION AND COERCION . . .
>
> A chant you can take to the streets: COMPUTER POWER TO THE PEOPLE! DOWN WITH CYBERCRUD!

Nelson's "discovery," hypertext, is explained, along with the differences between big and minicomputers, basic programming, the history of IBM, and computer languages:

> By hypertext I mean non-sequential writing. Ordinary writing is sequential for two reasons. First, it grew out of speech and speech-making, which have to be sequential; and second, because books are not convenient to read except in sequence. But the *structures of ideas* are not sequential. They tie together every which way.
>
> And the pity of it is that (like the man in the French play who was surprised to learn that he had been "speaking prose all his life and never known it") we've been speaking *hypertext* all our lives and never known it.

Like Stewart Brand in *Rolling Stone*, Nelson foresees a new

dawn of digital hope, as computers all have screen displays and memory becomes cheaper (another accurate prediction):

> Computers offer an interesting daydream: that we may be able to store things *digitally* instead of *physically*. In other words, turn the libraries to digital storage; digitize paintings and photographs; even digitize the genetic codes of animals, so that species can be restored at future dates.

It may be that as a philosopher, sociologist, writer, showman, photographer, lecturer in art, and consultant to CBS Laboratories, Ted Nelson's vision is too broad, too globally ambitious, to actually get anything done. (He is also a masterful punner: "Where are the shows of yesteryear?," a pun in translation; "Does the name Pavlov ring a bell?"; "Hardening of the artistries"; "Thinkertoys"; and "Crazy Leica Fox.") But since 1960 he has been planning Xanadu, a global network of literature libraries that allows text retrieval, hypertext links, and a copyright and royalty micropayment structure. It is still, at the time of writing, a plan:

> Now the idea is this:
> To give you a screen in your home from which you can see into the world's hypertext libraries. (The fact that the world doesn't yet *have* any hypertext libraries—yet—is a minor point.)
> To give you a screen system that will offer high-performance graphics and text services at a price anyone can afford. To allow you to send and receive written messages at the Engelbart level. To allow you to explore diagrams. To eliminate the absurd distinction between "teacher" and "pupil."
> To make you a part of a new electronic literature and art, where you can get all your questions answered and nobody will put you down.

Ted proposed franchised "Mom-and-Pop Xanadu Shops." He drew plans for the layout of such venues, with a reception and snackbar area, an equipment pit, and carrels for users to sit in and log on. Today we would call them cybercafés, or the rapidly expanding Cybersmith chain. Where McDonalds' Golden

Arches attract one type of traffic, "The Golden X's welcome the mind-hungry traveller."

Ted was even wooed by the CIA. "They told me they would be glad to set me up in business as a hypertext company, but I would have to have a corporation, because that was the way they always did things. And so it came to pass that The Nelson Organization, Inc. was founded at the express request of the United States Central Intelligence Agency. I wouldn't have had it any other way. If life can't be pleasant it can at least be surrealistic."

In the final paragraph of the book, Nelson makes an important realization: "That reminds me. Nowhere in the book have I defined the phrase 'computer lib.' By Computer Lib I mean simply: making people freer through computers. That's all."

Howard Rheingold was another member of the Sausalito circle, a *Whole Earth Catalog* writer who felt, in 1968, that "conforming to the program" of church, government, or corporation (even IBM) was a dead end. "You have to try to build a life that's meaningful for you and try to think for yourself. That's not easy to do. The *Whole Earth Catalog* was a great pointer to tools for that, and computers were nowhere in that picture. Computers were the tool of the bureaucracies. They were trying to fit us into pigeonholes. The idea that computers could really be used for extending our intellects and communicating with each other was something that didn't emerge for a while."

But with the work of Engelbart, the emergence of the ARPAnet, the buzz that Stewart Brand and *Rolling Stone* and Resource One were all building, Rheingold and thousands of others began to understand that computers could take on a socially and politically liberating and liberated role: "We're very fortunate that the administrators of ARPA were visionary and saw that this research tool that the Defense Department had funded was, in fact, a new communication medium. In fact, many of the people in Doug Engelbart's outfit and in ARPA were counterculture kind of people, and I think that it's not so much anti-establishment as empowerment of the individual. The belief that if you can give people tools, they can do things. They can make the new, better society. And that doing some crusade to create some great cause has failed."

It is one of the greater ironies of computer history that the vision of the hippies had to be married to the technology funded

and fostered by the Pentagon, before a world of integrated information and communication became possible. From Vannevar Bush, to Licklider, to Engelbart, to Nelson, the goals were relatively clear; but half a century has elapsed while they have been reached. As Ted Nelson told Howard Rheingold in 1983, quoted in the latter's *Tools for Thought*, "It seemed so simple and clear to me then. It still does. But like so many beginning computerists, I mistook a clear view for a short distance."

While futuristic thinking was generally outpacing the technology, there was one location where well-paid computer scientists were already "living in the future." Since 1970, the Xerox Palo Alto Research Center had been pushing at the limits of computer technology. One of those who signed up early was Bill English, Doug Engelbart's partner at the landmark demo, who quit ARC (Augmentation Research Center) with others in 1970 to join PARC. He was soon followed by Larry Tesler, the kid who broke the drum belt at Columbia, incorporated his consulting firm at age eighteen, and shocked Xerox by turning down their first offer for him to join PARC. Their second offer was better. Tesler joined a research group named POLOS, or PARC On-Line Office System, which was led by Bill English. The computer science laboratory was managed by Bob Taylor, who had moved on from Utah after just a year.

This was the hothouse of research opportunity to which MIT sentenced Bob Metcalfe when they decided not to give him a faculty job in 1972. Xerox offered Metcalfe a job, and he took it after striking a deal. His freshly minted Ph.D. thesis had analyzed Alohanet in Hawaii; now he wanted to make a research trip to study it firsthand, for an extended period. As his host, Norm Abramson, recalls: "Bob had just finished his Ph.D., and he had taken a job at Xerox PARC. Bob is a consummate salesman. Imagine this: if you had just gone into a new job, before you showed up for work, you get your boss to send you to Hawaii for three months. Bob did that. He spent that time with us, looked at what we were doing, did some stuff on his own, and went back and took some of the ideas that we had and changed them in very significant ways to come up with Ethernet."

In 1973, at Xerox PARC, Bob Metcalfe and his colleagues would develop Ethernet, the next big advance in networking computers. In fact, it was the first technology to network personal computers.

Remember what Stewart Brand said—that "Computers are coming to the People... the best thing since psychedelics." But Xerox PARC's staff of computer wizards, largely hand-picked by Bob Taylor, was not tripping. Personal computers didn't exist yet, with one exception: at Xerox PARC they'd already built them. Living in the future had its advantages. And Bob Metcalfe would later leverage that opportunity, using his talent for both engineering and entrepreneurship, into a hugely successful networking company. But to Norm Abramson, Metcalfe's engineering wizardry was ultimately less striking than his chutzpah: "The most impressive thing for me was convincing his boss to send him to Hawaii for three months before he showed up for work."

however useful his proposal would be to the scientists there, it was difficult to get their attention: "I wrote a proposal saying that a global hypertext project was going to be really important for the high-energy physics community, and the proposal's on the Web now. That was March 1989 and nobody really knew what to do with it. There was no system to pick it up, and CERN really was not a place where one was suppose to be doing information technology. One was supposed to be doing high-energy physics."

The work evolved thanks to the fortuitous location of CERN's Proton Synchrotron Control Division's coffee shop, between the offices and computer rooms used by the people who needed to share their information: "The only place where you could get this information about this interdependence would be by asking over coffee. As it happened, by luck or judgment, the coffee place was [at the junction of] four corridors. Two of which went to the offices and one of which went to the computer room and the terminal room. So there was a constant flow of all the people involved in computing through the coffee area."

Based on "Enquire," the new proposal was intended to allow CERN's scientists to combine their knowledge in a web of hypertext documents: "I started in October 1989 writing a program which I called World Wide Web. When you were reading something you could, if it's interesting and you've got write-access to it, you could just highlight a phrase, hit a hot key (control shift N) and it would bring up another window."

Tim wrote the software for the first World Wide Web server, and for the first client—a "WYSIWYG" hypertext browser/editor. By December 1990, it was in use inside CERN. In 1991, CERN embraced Tim's achievement and published the code on the Internet, making it available to all users—for free—by the summer of 1991. It very rapidly proliferated—and within four years the World Wide Web was sending more packets on the internet than any other service—because Tim had wanted the particle physicists to know more about what each other was doing.

One of the oddest aspects of this story is that Tim Berners-Lee's idea was not new. More than twenty years earlier Ted Nelson, author of the seminal hacker work *Computer Lib* had proposed something similar—his digital paradise was named

Xanadu, after Coleridge's poem "Kublai Khan," a "magic place of literary memory."

> In Xanadu did Kublai Khan
> A stately pleasure dome decree,
> Where Alph, the sacred river, ran
> Through caverns measureless to man
> Down to a sacred sea.

Xanadu was immensely ambitious, measureless indeed. Today Ted Nelson is based at Keio University in Japan, which happens to be the third international base of the World Wide Web Consortium (W3C). The others are MIT, and the French national computer research institution.

Nelson had his vision of a World Wide Web in 1960—an astonishing leap of the imagination—before computers had terminals, let alone keyboards, mice, and GUIs. Xanadu was not only inspired *by* literature, but it was designed to *store and index* the world's literature, on databases, for reuse, quotation, and micropayment of royalties. As Nelson describes it: "The original intention was to create a generalized electronic networking and publishing system that would take care of stability; allow reuse, deep interconnection, deep annotation; and allow every piece to be quoted virtually. It's a very simple idea. I've had it thirty-six years; it's still a simple idea."

Access to Xanadu would be through electronic links which Ted Nelson called "hypertext." This is defined by the *Microsoft Press Computer Dictionary* as "text linked together in a complex, nonsequential web of associations in which the user can browse through related topics." In theory, instead of linear relationships between passages of text (one reads to the end of one before beginning to read the next), there are dynamic links between texts, driven by ideas and associations. In practice, hypertext is embodied in the highlighted or underlined text on a Web page or document; hypertext links allow the user to jump from one page to another by hitting the "hot button." The button conceals a new instruction ("Go to XYZ...) but all the user sees is the button, and then the new page. Ted Nelson coined the phrase but denies the invention: "Hypertext is obvious. I do not claim to have in-

vented hypertext. I merely discovered it. It's like the telephone. The telephone, at the time, seemed to be an invention. To us, now, it's a discovery because it's obvious. Hypertext is like that. To me, it was simply the obvious next step of literature."

While Tim Berners-Lee was met with skepticism and passivity, Ted Nelson—with his hyper-energetic and eccentric presentation of ideas—received more disparaging responses. This despite the fact that his ambitions were squarely in the mainstream of the Bush-Engelbart-Licklider tradition of computers' making human efforts easier and more efficient: "People always just laughed at what I said. They thought I was spouting gibberish apparently, and I've never uttered gibberish in my life, except plainly marked. The whole point was always getting the same ideas across to people: that we have to multiply human intellect."

Coleridge's vision of Xanadu was dispelled when the person from Porlock knocked at the door of his cottage and banished his possibly opium-induced reverie. Nelson's modern Xanadu has proved to be equally insubstantial. But hypertext has become central to the World Wide Web, as Tim Berners-Lee acknowledges: "The power of a hypertext link is that it can link to absolutely anything. That's the fundamental concept. The fundamental idea was anything which was out there somewhere sitting on a computer disk where that computer was attached to a network you ought to be able to give it an address, you ought to be able to make a link to it."

At the time that Berners-Lee embarked on the Web project, there were about 800 different computer networks attached to the Internet, with about 160,000 computers attached to them, all with files and databases containing information that one might want to access. The World Wide Web program established three core components, all known by their acronyms: URL, the Universal Resource Locator; HTTP, HyperText Transfer Protocol; and HTML, HyperText Markup Language.

In simple terms, the URL is what we might call an address; HTTP is the client/server protocol which defines a universal method for transmitting text and graphics over TCP/IP so that pages appear identical regardless of the computer system used; and HTML is a language that describes how graphics and text should be displayed when they are delivered. The Web works on

a client/server model: the individual user is requesting material stored on local or distant computers; and the Web application goes out to find, retrieve, and deliver it. Until the Web existed, it was technically possible to do all this, as Tim Berners-Lee is first to note: "It was basically technically trivial to go and get it. It just happened that you had to be a guru of the highest degree to actually be able to navigate all the networks and figure out all the programs that you would come across on your way and know what commands to give them to actually get the data back. Chances are, when you got it back you wouldn't be able to read it anyway, because of all the incompatibility."

Rohit Khare is a Web wunderkind, whose career has already included a spell as an executive of the World Wide Web Consortium in Cambridge. He has subsequently become a Ph.D. student at the University of California, Irvine, developing new Web protocols and studying the process of Internet standardization. At the age of twenty-two, he has as much hands-on experience of the Web as anyone: "The key insight I credit Tim Berners-Lee with, is the URL. The idea there's a Uniform Resource Locator that says I can point at any particular bit of information on the Internet. If I mean that you should go to this university, look in their FTP [File Transfer Protocol] archive, and download this picture of a Corvette and put it up on the screen, I now have a way of doing that. Whereas before I would have actually had to send you an e-mail telling you use your file transfer client, go to Washington University in St. Louis and go to the graphics directory and get the Corvette."

This is the streamlined, user-friendly procedure that has created the proliferation of http//www. addresses on every billboard. bus, and magazine of the nineties. Every Web site has its unique URL, or Web address, and the growth of sites has been breathtaking. By the end of 1997, there were about 1.5 million "domain names," more than double the number one year earlier. Appropriately enough, the very first United States Web site belonged to the Stanford Linear Accelerator Center. The reason, no doubt, was that SLAC is in the same particle research business as CERN. But SLAC was also the principal venue of the Homebrew Computer Club, that band of pioneer nerds devoted to the personal use of computers *ab initio*. In another apt event, Tim

Berners-Lee left CERN to take on a senior role in the World Wide Web Consortium at MIT, based in Tech Square—where Licklider started (and indeed ended) his years of advocacy for Man-Computer Symbiosis. The Web was undoubtedly a major step along that path.

Ted Nelson admires the method that led to the creation of the Web, but not the result: "Tim Berners-Lee figured out that the key was extreme simplicity, and that's very painful to me because now the websters are trying to grapple with all the issues we were trying to solve in a single design at the beginning. The World Wide Web is pretty awful. I mean, I dearly love Tim Berners-Lee and I think he's a great guy and a wonderful idealist and he just achieves wonderful things. But the unfortunate thing about the World Wide Web is just how messed up it is."

By contrast, Bob Taylor—the man who set the very first phase of networked computing in motion at the Pentagon—argues that the Web's achievement has been in overcoming the mess, and creating something that works in spite of it: "It was a tour de force. The people who did the World Wide Web were really willing to take existing pieces of things, in God-awful condition in some cases, and figure out a way to make it work. Whereas the ARPA people and the Xerox people were trying to create new things that were precious from the beginning, that were right. They were less willing to work with junk, or things that they thought were junk. The World Wide Web people deserve a lot of credit for what they did. What they did was very difficult."

Like the ARPAnet, the World Wide Web is not a commercial product, and no one has made any money by selling the Web application. As a consequence, according to Rohit Khare, it has evolved quickly, and in a collaborative fashion: "The Web is a success precisely because it is not a monolithic new software product. You don't get Web 9.0 in the mail on a CD-ROM. The Web is a collection of a whole bunch of small technologies that fit together because a couple dozen people all thought about how they'd work together cool. They're all being evolved constantly in realtime by thousands of people around the world. There isn't any central release. You can't go anywhere to go buy a copy of Web."

Dave Walden, the ARPAnet software scion from BBN, likes to quote his colleague Dave Clark at MIT on why standards become

accepted: "Strong consensus and working code. We don't have to have everybody agree, just if enough agree. And we're not interested in theories about what might be, we're interested in what works. Tim Berners-Lee followed that pattern. He brought out something, he gave it to a few of his friends, they tried it, they saw that it was good, and he gave it away. It went all over the world. That's how the World Wide Web standard came on the world. Strong consensus and working code."

The trends of networking, from the sixties to the eighties, saw a general movement from federally funded, noncommercial research efforts to increasingly commercial motivation, and battles for consumer markets. ARPAnet and Alohanet prepared the ground for Ethernet, Netware, Cisco, and Prodigy. But the World Wide Web reversed the trend, in a way that recalls the idealism of some of the pioneering advocates of networking. Tim Berners-Lee reflects: "I think the main intention was to make the thing fly. When you're really attached to a dream of how things could be, then you pursue that dream and it's very, very satisfying to see it work. The fact that the World Wide Web did work, I find is just exciting for itself. Exciting that you can have an idea and it can take off and it can happen. It means that dreamers all over the world should take off and not stop."

Irving Wladawsky-Berger, who today has the daunting task of directing IBM's company-wide strategy for the Internet and Web environment, has an appropriately literary analogy for Tim Berners-Lee's remarkable innovation: "In *War and Peace* Tolstoy had an appendix where he asked the question: 'If Napoleon hadn't been born, would we still have had the invasion of Russia?' He concluded, yes. There are these historical winds and somebody like Napoleon would have been born. I suspect that if Tim hadn't done his great work at CERN, somebody else would have done something similar to Tim. Maybe not as elegant. Maybe not as quickly, but I think it was inevitable that something like this would happen. So it was an idea whose time had come and it was a matter of time before it happened."

Perhaps it is appropriate to give the last word on the World Wide Web to Ted Nelson—who perhaps had the idea before its time—a man whose perfectionism is only exceeded by his restless evangelism for the interconnection of our Dream Machines:

"On the one hand, the World Wide Web is such an abominable garbage heap compared to what we were trying to build; and on the other hand, when I look at it I say, my God, look what it's done for the world. I think that the Internet has already done more for the human race than all the religions of history in terms of bringing us together and making us feel like one world. The World Wide Web is an astounding resource. It's not what it should be, but considering what it is and the fact that everybody and his uncle is putting stuff out there that is potentially useful and interesting . . . Gee whiz!"